CLEMSON UNIVERSITY
CHEMICAL ENGINEERING
Fall 2003

MAPPING THE FUTURE OF CHEMICAL ENGINEERING

Chemical Engineering is changing rapidly from a profession heavily invested in the petroleum and chemical industries, where the majority of graduates have been employed historically, to a field that incorporates biochemical engineering and other disciplines. This paradigm shift in the profession has prompted departments around the country to evaluate their programs for relevance. Some have even changed their names , for example to Chemical and Biochemical Engineering or Chemical and Biomolecular Engineering.

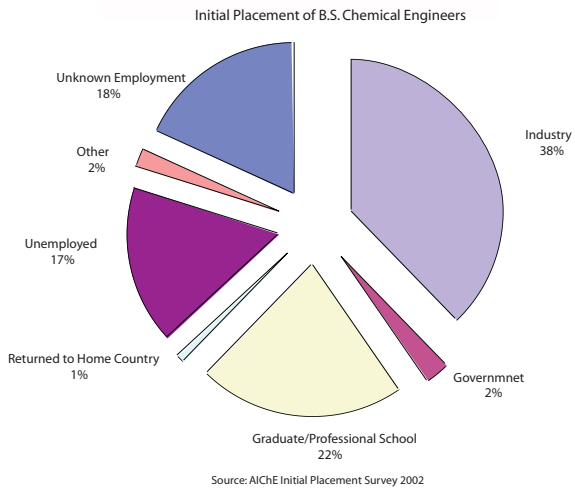
The Clemson ChE faculty have spent considerable time this year addressing ways in which the undergraduate curriculum must adapt to what can be seen as "market influences" that affect our students' ability to compete for jobs. Data such as the AIChE annualplacement survey represented by the pie chart in this article are used in forecasting curriculum revisions.

"Most curricula were designed in the 1950s to reflect the needs of the times. Discussions now taking place on a national level through a series of National Science Foundation-funded workshops will shape the nature of chemical engineering education for the 21st century," Goodwin said.

One result of the discussions is acknowledging that the foundations of chemical engineering are no longer limited to chemistry, mathematics and physics.

The basic concepts remain the same, with Chemical Engineering firmly grounded in kinetics, thermodynamics and transport phenomena; but the challenge will be how to integrate biotechnology and how to do a better job of integrating polymer science into the curriculum.

"An example of the current disconnect," Goodwin added, "is that if one wants to study the thermodynamics of organic, polymeric, and biological molecules, it is necessary to go to three different textbooks that utilize three different terminologies. We must do a better job of integrating science for our students."



Part of Clemson's discussion is the university's move to a requirement of 120 to 130 total credit hours without the 10 free electives that students have used to pursue their special interests.

Discussions about the curriculum and the future of the program are not limited to the academic community.

"Some of our most important information will come from our alumni," Goodwin said. "It is crucial that we hear from those who are dealing with the changes in their industries. We must make the curriculum more relevant as well as flexible enough to reflect the diversity of career options available to our graduates."

Goodwin urges all alumni to email him their thoughts about what must be included in the curriculum. Contact him at jgoodwi@clemson.edu and read more about the curriculum discussion on page 2.

Solid Orange ChE!
Page 7

FRENCH FRIED FUEL HAS CU ChE RESEARCHERS COOKIN'

As ironic as it seems, eating more French fries could help secure America's energy independence. Oils used to cook many fast-food menu items can be recycled to diesel fuel, and **Professor James G. Goodwin Jr.**, has been awarded nearly $900,000 from the U.S. Dept. of Agriculture to improve the process.

Goodwin's research team, which includes **Associate Professor David Bruce**, will focus on the development of solid acid and base catalysts.

"The process now primarily uses a liquid base catalyst, sodium hydroxide, which can be corrosive to equipment and reacts to form soap as a by-product, requiring more expensive separation," he said. "Solid catalysts do not need to be removed because they do not mix with the biodiesel product." The materials being researched are not corrosive, thus reducing wear and tear on production equipment.

Biodiesel can be used to power engines in vehicles and electricity-producing generators. Currently it is available in at least seven states, including South Carolina, according to USDA Office of Energy information. From 2000 to 2001, U.S. sales rose from about seven million gallons to more than 20 million gallons. It is slightly more expensive than conventional diesel, although the price has decreased in the past year.

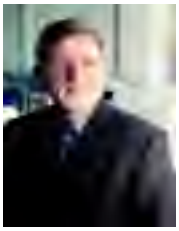
Biodiesel fuel can benefit farmers, too. While recycled restaurant cooking oil accounts for about half of U.S. biodiesel production capacity, the other half is directly from soybean oil. In South Carolina, soybeans rank No. 1 in acres planted.

A 1996 economic study published by the USDA Office of Energy predicted that a modest, sustained annual market for biodiesel of 100 million gallons in the U.S. would contribute approximately seven cents to the price of each bushel of soybeans produced in the nation.

Biodiesel can create jobs and income. According to University of Missouri researchers, 100 million gallons of biodiesel production could generate an estimated $8.34 million increase in personal income and more than 6,000 additional temporary or permanent jobs for a metropolitan region.

-- Clemson University News Services

A NOTE FROM THE CHAIR



James G. Goodwin, Jr., Ph.D.
CU ChE, B.S. '67

The front-page article about our efforts to refine the curriculum outlines the challenge we face to make this department as competitive as possible in recruiting, retaining and educating chemical engineers for the future. To paraphrase a once-popular advertising slogan, "It's not your father's (or your mother's) chemical engineering degree." The profession is changing at a rapid pace, and today's graduates face many challenges.

In the current competitive job market, students should be able to take advantage of options beyond what they might have considered their original career options. Biotechnology is only one example of the expanding job market for chemical engineering graduates.

A recent AIChE report on employment trends in 2002, while not addressing the increasing emphasis on biotechnology *per se,* does offer insight into the kinds of companies that are hiring our students. According to the report, while the greatest percentage of B.S. graduates were hired by industry, the second highest share was claimed by electronics, with fuels following closely. Pharmaceuticals continued its upward trend, and business services, which includes consulting, financial and other aspects of business, did not change appreciably.

Nontraditional companies account for approximately 50 percent of new B.S. jobs. In addition, there is a sizeable group in each graduating class that enters graduate school in ChE, materials, environmental science and engineering, bioengineering, medicine and law. Some graduates also go for their MBA after several years of work experience. Obviously, any ChE B.S. curriculum needs to recognize these changes and in some fashion provide a means to accommodate the different needs of different students.

Your input is critical to our efforts to revamp the curriculum in any meaningful way. I urge you to email me your thoughts about what should be retained, what should be deleted, and what should be added. Obviously each person's experience will be somewhat different, but it is this composite view that will allow us to devise an optimum curriculum. Please email me your thoughts at jgoodwi@clemson.edu. For data purposes, please include your job title, company, industry type or profession (chemicals, fiber, electronic materials, medicine, law, etc.), and year of graduation for B.S. and/or any other degrees.

Thanks in advance for helping us move the department and its graduates into the 21st century.

EMERITUS

Joseph C. Mullins, Ph.D.

Although he retired officially in 1994, **Dr. Joe Mullins** continues to pursue his research interests and is a daily presence in the department. His most recent work has been working on tutorials and research on the use of ASPEN and HYSYS computer programs. As former students will remember, his other passion is tennis; and he continues to play and to coach a fortunate few promising young players.

Assistant Professor Andrew T. Metters has received the Ralph E. Powe Junior Faculty Enhancement Award presented by Oak Ridge Associated Universities to a first-year faculty member who shows exceptional promise.

Professor Amod Ogale was the keynote speaker for a Thermoplastics Symposium at the Japan-SAMPE International Conference November 18-21 in Tokyo. His presentation was based on research results from a Ph.D. study being conducted by his student, S. Cherukupalli. They investigated online monitoring of structure during blown-film extrusion of polyolefin films, and their paper won the symposium's award for best paper. Prof. Ogale was also invited to present a lecture on the rheostructural studies of liquid crystalline polymers at another polymer symposium organized by Yamagata University in Yonezawa, Japan. Both of the studies are being conducted under the auspices of the Center for Advanced Engineering Fibers and Films (CAEFF), an Engineering Research Center funded by the National Science Foundation.

L-R: Symposium organizers Prof. Ito and Dr. Mizoguchi (Tokyo Institute of Technology), Prof. Kim (Hanyang University, S. Korea), Prof. Liu (Chang Gung University, Taiwan) and Prof. Ogale.

Faculty

Charles H. Barron, Jr., D.Sc.
Polymer Reaction Engineering

David A. Bruce, Ph.D.
Catalysis, Kinetics, Molecular Sieve Synthesis, and Molecular Modeling

Dan D. Edie, Ph.D.
Director, Center for Advanced Engineering Fibers & Films
Composite Materials, High-performance Fibers, Polymer Processing & Rheology

Charles H. Gooding, Ph.D.
Membrane Separation Processes

James G. Goodwin, Ph.D.
Department Chair
Heterogeneous Catalysis, Kinetic Analysis of Surface Reactions, Characterization of Catalysts

Sarah W. Harcum, Ph.D.
Biochemical Engineering; Protein Production

Graham M. Harrison, Ph.D.
Fluid Mechanics & Non-Newtonian Flow

Douglas E. Hirt, Ph.D.
Polymer Films

Scott M. Husson, Ph.D.
Bioseparations and Separation Materials Synthesis

S. Michael Kilbey II, Ph.D.
Polymer Science; Surface Modification via Self-Assembly

Stephen S. Melsheimer, Ph.D.
Automatic Control of Process Systems
Associate Dean, Engineering & Science

Andrew T. Metters, Ph.D.
Bioengineering; Polymer Science

Amod A. Ogale, Ph.D.
Experimental & Modeling Issues Related to Fibers, Films & Composites

Richard W. Rice, Ph.D.
Catalysis, Kinetics, & Chemical Reactors

Mark C. Thies, Ph.D.
Separations; Supercritical Fluids Processing

Edie

Basova

Professor Dan Edie and **Dr. Yulia Basova**, a post-doctoral researcher in the Center for Advanced Engineering Fibers and Films, attended the International Carbon Conference in Oviedo, Spain, July 6-10. They presented two papers covering their research in activated carbon fibers, one of which was selected as a keynote address at the conference. Prior to the conference Edie attended a workshop on carbon materials at the University of Alicante in Alicante, Spain, where he made an invited presentation entitled "Future Directions in Carbon Fiber Research."

Associate Professor S. Michael Kilbey II is co-principal investigator on a $1.86-million National Science Foundation-funded project to investigate a novel chemical process to modify and control interfaces with multiply-bound polymer chains (MBPCs).

Kilbey joins a multidisciplinary team of researchers from the University of Tennessee, the University of Houston, and the University of Utah. The program will provide a training ground for undergraduate and graduate students; a number of experiments will be carried out at National Laboratories, including the National Institute of Standards and Technology, Oak Ridge National Laboratory, and Sandia National Laboratory. Science teachers from public high schools and junior colleges also will spend four weeks in research laboratories contributing to this project, providing exposure to polymers and polymer research.

Professor Mark Thies (back row, right) was an invited VIP for the 12th European Symposium on Improved Oil Recovery held in Kazan, in the Republic of Tatarstan in September. The major topic for the symposium was the recovery of heavy oils from mature oil fields and the problems associated with processing these high molecular-weight materials. The symposium brought together leading engineers, managers, and scientists from the U.S., Canada, Europe and countries of CIS and Asia.

"I was really impressed with how much faculty and students are able to accomplish with so few resources available to support teaching and research," Thies said. "We sometimes forget how fortunate we are in this country."

FACULTY FACTOIDS*

ChE faculty speak the following languages
French: Goodwin
German: Thies, Melsheimer
Spanish: Kilbey
Hindi and Marathi: Ogale

**Little-known tidbits of TOTALLY USELESS information about the Chem E faculty.*

REU 2003

L-R: David Bryson, Matt Garrett, John Oldham, Vee Sykes, Curran Chandler, Brian Figura, Prof. Graham Harrison, Josh Barringer. Absent (right): Kim Abrams

For the second consecutive year, eight undergraduate students from chemical engineering programs across the United States spent 10 weeks of their summer break in the department as researchers in the National Science Foundation-funded Research Experience for Undergraduates (REU) in Novel Materials organized by **Assistant Professor Graham Harrison**. Students participating this year included Kim Abrams, South Carolina State University; Josh Barringer, Louisiana Tech; David Bryson, Georgia Tech; Curran Chandler, University of Southern Mississippi; Brian Figura, University of Pennsylvania; Matt Garrett, University of South Carolina; John Oldham, Rose-Hulman; and Vee Sykes, Norfolk State University.

Each student was assigned to a specific faculty member's research project. Along with Dr. Harrison, the faculty members who worked with the students were Professors Bruce, Goodwin, Hirt, Husson, and Kilbey. In addition to their laboratory research, the students had to present an oral report, a written report and a research poster to the faculty and graduate students.

"The REU experience is a great opportunity for students who are interested in research to learn all aspects of the process," Harrison said. "It is also a way for the department to showcase its various research programs to potential graduate students. We are looking forward to another great REU program next summer."

CO-OP A Valuable Job Search Tool for Seniors

Those seniors who have taken advantage of the Cooperative Education program are finding it a valuable tool in their job search. The program provides an employment opportunity during the undergraduate years and is an excellent way for students to find out whether or not they are suited to a career in chemical engineering.

Professor Charlie Gooding, a co-op advisor, says the program has been revamped to provide optimum experience for students as well as benefits for employers.

"As the program is designed now, students have their first co-op opportunity after they complete the sophomore year. This gives them a good foundation in the basic chemical engineering course work and a bit more maturity. This is a benefit to the employers, too, since the students have been exposed to the knowledge they need to be productive employees."

Several seniors have already accepted positions with the companies where they spent their co-op time, and others say the experience helped them define their career goals more clearly.

"We are always interested in new opportunities for students, especially as the profession changes and new career opportunities arise. Anyone who has a co-op opportunity for our students can email me at chgdng@clemson.edu and we'll explore the possibilities."

Top 10 Reasons Women Choose Chem E

L-R: Leslie Jerrim (B.S. '03), Melissa McAllister, Carmen Eleazer, Michelle Malecha, Stephanie Ward and Isabelle Beck show off the shirts.

The shirt says it all: Chemical Engineering is not every girl's idea of fun, but those who pursue the profession reap its many rewards. Just ask the women pictured here about those advantages. During one of many late-night study sessions -- yet another weekend spent in Earle Hall -- they decided to list the many "blessings" of being a female chemical engineering student and, ultimately, a chemical engineer. The list was an instant hit with their female classmates, so they decided to put it on a T-shirt.

A sampling of the Top 10 reasons:

- We can buy our own diamond ring.
- Chances of marrying a rocket scientist increase exponentially.
- You don't have to worry about finding a date for the formal because you don't have time to go.
- Free housing in Earle Hall.
- Getting a 51 on a test means you got more than half the answers right.

Want one? Know a female chemical engineer who might?
Email Sandra Woodward at woodwas@clemson.edu for ordering details!

Chem E Family Album

Senior Photo, Class of 2004

Graduate Students, 2004

Shrimp Boil!

Senior girls let off steam at the Upper SC State Fair.

Faculty and graduate students enjoy the annual river rafting trip.

Senior Intramural Coed Softball Team, aka "*A Real Hell*."

Francis Sinclair Webster, Jr., B.S. '42

We were saddened to learn that **Francis S. (Frank) Webster, Jr.,** passed away August 6. A retired executive with 3M, Webster was a resident of Hilton Head, SC. In 2002 Mr. Webster established a $25,000 unrestricted endowment to support the department. The Webster Endowment will play a major role in the future of Chemical Engineering at Clemson, according to Development Officer Sandra Woodward.

"We are very grateful for Mr. Webster's commitment," Woodward said. "The proceeds from this gift will be used in ways that will strengthen the department and provide support for our students. Through his generosity , Mr. Webster's memory will always be honored in this department."

Paul J. Campbell, Jr. (B.S. '68) and Vicki G. Campbell Create Endowment

Paul J. Campbell, Jr., B.S. '68 and Vicki G. Campbell have created a new unrestricted $25,000 endowment for the department. Paul is executive vice president with Alcoa in Charleston. He and Vicki live in Goose Creek, SC. Proceeds from the fund will be used to enhance the educational program.

Sorry, Charlie! *Despite our best efforts, Charlie Miller was omitted from the list of the ChE Class of 56 members who attended a March reunion in Charleston. Miller is pictured here with his wife, Sarah.*

Guest	*Book*

- **David Detwiler, B.S. '68** and his wife, Diane, visited the department Oct. 6. David retired in 2001 as Vice President, Asia for Nalco/Exxon Energy Chemicals, an Exxon joint venture. Before that he worked for Exxon for 26 years. The Detwilers had lived in Singapore for six years at the time of his retirement and now live in Austin, TX.

- **Monica McDill Roberson, B.S. '98**, stopped by for an afternoon visit before the Florida State football game. Monica works in technical sales and marketing for ExxonMobil.

- **Dr. Priscilla Hill, B.S. '82, M.S. '84**, presented a graduate seminar and met with the faculty Oct. 30. Her topic was "Effect of Breakage on the Particle Size-Shape Distribution in a Stirred Vessel. Dr. Hill received her Ph.D. from the University of Massachusetts in 1996 and is an assistant professor of chemical engineering at Mississippi State University.

- **Dr. Suzanne Roat, B.S. '85**, visited in November. She has just taken a position with the Cenex refinery of CHS near Billings, MT, and recently completed another Ironman Triathlon in Panama City, FL.

- **Amy Smith, B.S. 2001,** and her husband dropped by on a football Friday afternoon this fall. She works for Micron in Boise, ID.

- **Ricky Coats, B.S. '86, M.S. '90**; and **Megan Najjar, B.S., '02** met with seniors this fall. They are with Albemarle Corp. in Orangeburg, SC.

You are cordially invited to stop by whenever you are in the area. Students and faculty benefit from hearing about your work and other experiences since leaving Clemson.

Endowment

The Gift That Keeps On Giving

The two endowments noted above, and another we expect to announce in the next newsletter, are the most recent examples of the generosity of our alumni. An endowment, which provides a fund from which a portion of the interest earned can be used annually by the department, creates a gift that literally lasts forever, since the principal cannot be spent and will continue to earn interest each year. There are many ways endowments can be established. The gift can be a lump sum or can be spread out over a period of time up to five years.

Development Officer Sandra Woodward can answer questions for those wishing to consider this as a way to make a lasting gift to the department. Contact her by email at woodwas@clemson.edu or by telephone at 864-656-2055.

ChE Alumni Respond to Solid Orange Challenge

What can we say except THANK YOU?! To everyone who responded to Dr. Goodwin's letter asking for support, and to those who offered support without being asked, we offer our heartfelt thanks. The response has been very exciting and encouraging, and girls continued to come in as we prepared to go to press. We will offer a detailed report in the next newsletter , but let us offer a few preliminary observations:

- With a couple of notable exceptions, the number or donors increased at every level. Individual giving in the ranges from $0-99 and $100-$249 almost doubled. Many first-time donors will naturally fall into these categories, and we are pleased to welcome them.
- The prompt response to the letter was very heartening. Many of you recognize the serious state of the university budget and understand the importance of your private, unrestricted gift to support the department.
- The honor roll of donors includes many who have not contributed regularly in the past.
- A number of regular donors either increased their annual gift or made a special additional gift in response to the letter.
- The significant increase in the number of individual donors is a very important point for the department and the university overall.

If you did not receive a letter, please email our development officer, Sandra Woodward, at woodwas@clemson.edu.

If you have not yet made your gift, please use the form below and the enclosed envelope to join your classmates along with students, faculty and staff, in showing our commitment to the department. If you prefer, you may make your contribution online at **http://www.clemson.edu/itrans/index.cgi.**

Because of the increase in the number of donors, we are including our Honor Roll of Donors 2003 as a separate insert. Please review the list and email Sandra Woodward at woodwas@clemson.edu or call her at 843-656-2055 if your name should be listed and is not or if your gift has not been credited appropriately. The dates covered by this list are Nov. 1, 2002-Dec. 1, 2003. If you made a gift toward the end of this period or later, your gift will be noted on next year's list AND on the list we will be posting soon on the web site and which we will update monthly to reflect the current status of gifts received.

Clemson University Department of Chemical Engineering

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*The enclosed envelope is provided for your convenience and in order to direct your gift to the appropriate address. If paying by check, please make your check payable to **Clemson University Foundation** and write **Chemical Engineering** on the for line.Thank you for your support.*

A Final Note

The newly renovated Littlejohn Coliseum.

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